# IGS Scheduling

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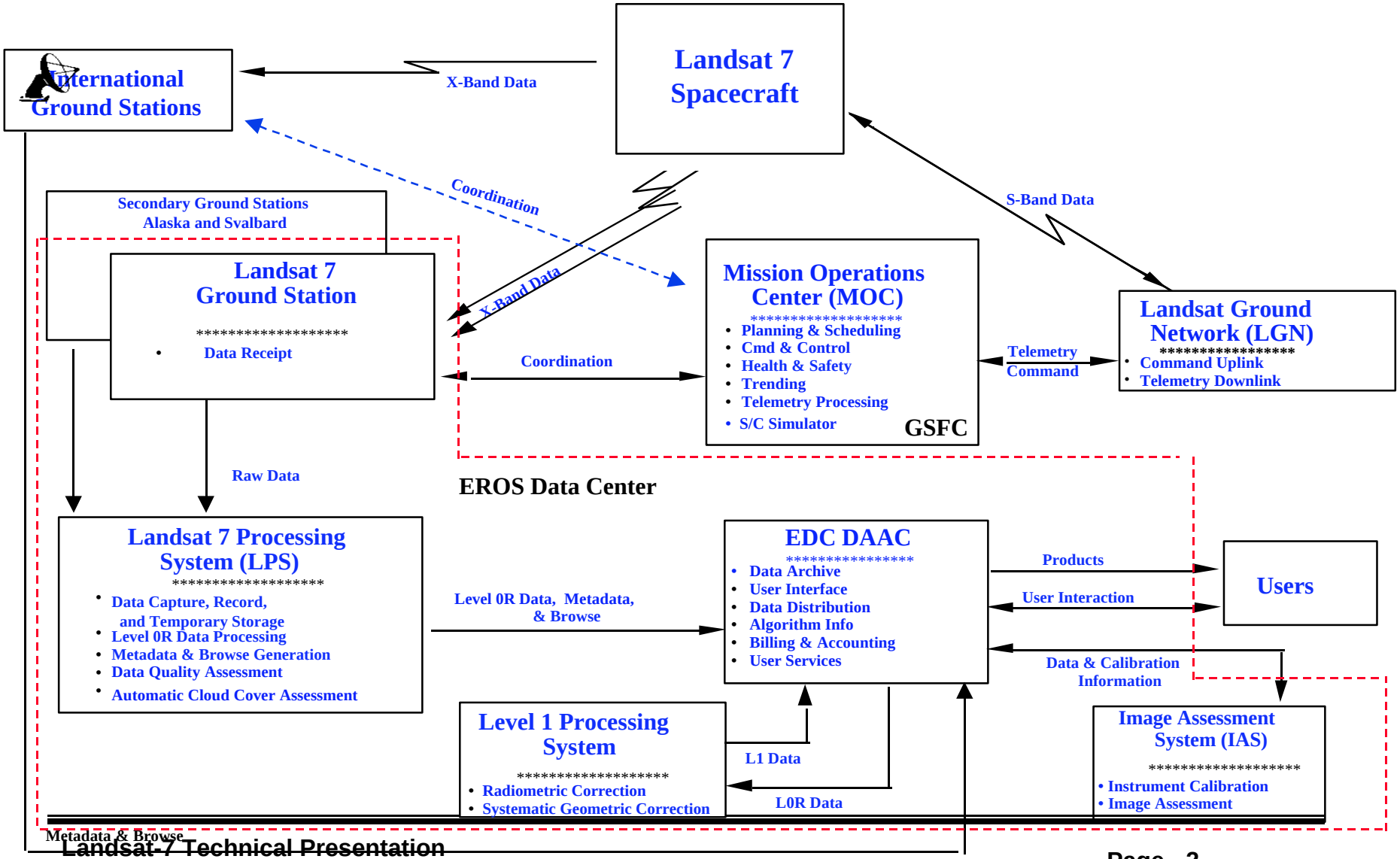
# Landsat 7 Ground System



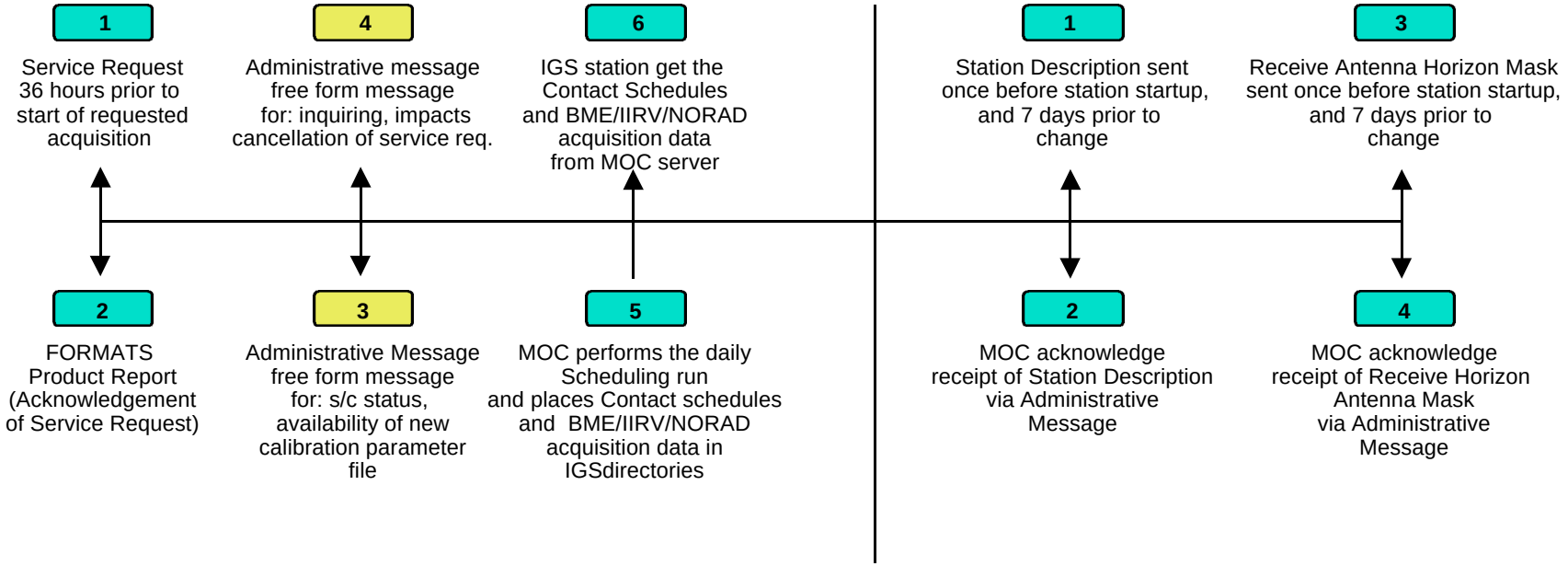
# *IGS Scheduling Agenda*

- **Planning Products**
  - **IGS Product Timeline**
    - **Service Requests**
    - **Formats Product Reports**
    - **Acquisition Data**
    - **Contact Schedule**
    - **Calibration Parameter File Report**
    - **Problem Report**
  - **IGS Scheduling Data Flow**
  - **Electronic Transfer**
- **Non-Imaging Scheduling**
  - **Routine Spacecraft Housekeeping Activities**
  - **Non-Routine Activities**
- **Image Scheduling**
  - **Tools**
  - **Resource Constraints**
  - **Scheduling Process**
  - **Load and Activation Timeline**

# IGS Scheduling Timeline

## IGS Operational Support

## IGS Non-Operational Support




Notes:

= Required Message

= Optional Message

**MOC**

# *Service Requests*

**Filename : L71998111PACREQ.S00**

TYPE: REQ

DTG: 1998/127:11:00:00

S/C ID: 7

START PATH: 031

START ROW: 012

STOP ROW: 035

EFFECTIVE DATE: 1998-05-09

EXPIRATION DATE: 1998-05-29

ACQ. RATE: 0

MINIMUM GAP: 016

MAX. SOLAR ZENITH ANGLE:

REQ. TYPE: PAC

S/C ID: 7

START PATH: 047

START ROW: 010

STOP ROW: 025

EFFECTIVE DATE: 1998-05-09

EXPIRATION DATE: 1998-05-29

ACQ. RATE: 0

MINIMUM GAP: 016

MAX. SOLAR ZENITH ANGLE:

REQ. TYPE: PAC

S/C ID: 7

START PATH: 063

START ROW: 012

STOP ROW: 013

EFFECTIVE DATE: 1998-05-04

EXPIRATION DATE: 1998-05-29

ACQ. RATE: 0

MINIMUM GAP: 016

MAX. SOLAR ZENITH ANGLE:

REQ. TYPE: PAC

TEXTEND:

# *Service Request Cont.*

**Filename : L71998111PACREQ.S01**

TYPE: REQ
DTG: 1998/127:11:00:00
S/C ID: 7
START PATH: 031
START ROW: 012
STOP ROW: 035
EFFECTIVE DATE: 1998-05-09
EXPIRATION DATE: 1998-05-29
ACQ. RATE: 0
MINIMUM GAP: 016
MAX. SOLAR ZENITH ANGLE:
REQ. TYPE: PAC

TYPE: REQ
S/C ID: 7
START PATH: 047
START ROW: 010
STOP ROW: 025
EFFECTIVE DATE: 1998-05-09
EXPIRATION DATE: 1998-05-29
ACQ. RATE: 0
MINIMUM GAP: 016
MAX. SOLAR ZENITH ANGLE:
REQ. TYPE: PAC

S/C ID: 7
START PATH: 063
START ROW: 012
STOP ROW: 013
EFFECTIVE DATE: 1998-05-04
EXPIRATION DATE: 1998-05-29
ACQ. RATE: 0
MINIMUM GAP: 016
MAX. SOLAR ZENITH ANGLE:
REQ. TYPE: PAC
TEXTEND:

# *FORMATS Product Reports Info*

FORMATS Product Report

L71998111PACREQ.S00xRPT
Date Generated: 1998:111:16:46:24

Product: 309_SVCREQ
Incoming File: L71998111PACREQ.S00

| Message Type | Message |
|---|---|
| INFO | L71998111PACREQ.S00 received by Transform. |
| INFO | [numReq2] (template line 210 input file line 35 offset 1028): 3 requests received |
| INFO | L71998111PACREQ.S00 passed validation using ls7_igsSvcRqst_val. TPL |
| INFO | L71998111PACREQ.S00 reformatted OK to L71998111PACREQ.S00.schRqst using ls7_igsSvcRqst_rfm.TPL |

Error count = 0
Warning count = 0
Total Messages = 4

# *FORMATS Product Reports Error*

FORMATS Product Report

L71998111PACREQ.S01xRPT
Date Generated: 1998:111:16:50:27

Product: 309_SVCREQ
Incoming File: L71998111PACREQ.S01

| Message Type | Message |
|---|---|
| INFO | L71998111PACREQ.S01 received by Transform. |
| WARN | [messages.wrongScIdLbl1] (template line 96 input file line 14 offset 398): We were hoping to see next the <S/C> part of the spacecraft ID label, but instead we read <TYP>. |
| WARN | [messages.wrongScIdLbl2] (template line 102 input file line 14 offset 400): We expected here to see <ID:> part of the spacecraft ID label, but instead we read the characters <E:>. |
| WARN | [messages.wrongScId] (template line 108 input file line 14 offset 422): We expected here to see <7> as the spacecraft id value but instead we saw <R>. |
| WARN | [messages.startPathLabel1Check] (template line 113 input file line 14 offset 424): Text ( messages.startPathLabel1:EQ,EQI, 'START') failed; |
| WARN | [messages.startPathLabel2Check] (template line 115 input file line 16 offset 431): Text ( messages.startPathLabel2:'S/C',EQI, 'PATH:') failed; |
| ERROR | [messages.startPathRangeCheck] (template line 117 input file line 16 offset 435): Numeric ( messages.startPath:'ID:',GE,1) failed, AND, Numeric ( messages.startPath:'ID:',LE,233) failed; |

Error count = 27
Warning count = 70
Total Messages = 99

# Acquisition Data

## BME

ORBITAL ELEMENTS REPORT
SPACECRAFT LANDSAT7 (7368001)

THE FOLLOWING ORBITAL ELEMENTS ARE BROUWER MEAN TYPE
COMPUTED AND ISSUED BY GODDARD SPACE FLIGHT CENTER.

COORDINATE SYSTEM IS INERTIAL EARTH-CENTERED
J2000 EQUATORIAL

EPOCH (YY MM DD HH MM SS.SSS)
98 7 9 0 0 .000

| | |
|---|---|
| SEMI-MAJOR AXIS | 7077.7476 KM |
| ECCENTRICITY | .00007080 |
| INCLINATION | 98.1752 DEG |
| R.A. OF ASC. NODE | 215.6875 DEG |
| LONG. ASC. NODE DOT | .9843 DEG/DAY |
| ARGUMENT OF PERIGEE | 58.6857 DEG |
| ARG. PERI. DOT | -3.1111 DEG/DAY |
| MEAN ANOMALY | 78.5530 DEG |
| PERIOD | 98.7648 MIN |
| PERIGEE HGT | 699.1102 KM |
| APOGEE HGT | 700.1124 KM |
| VELOCITY AT PERIGEE | 7.5050 KM/SEC |
| VELOCITY AT APOGEE | 7.5040 KM/SEC |
| LATITUDE OF PERIGEE | 57.7414 DEG |
| EAST LONGITUDE | 116.3996 DEG |
| GEODETIC LATITUDE | 42.2941 DEG |
| HGT | 708.2815 KM |
| X | 3828.43485900 KM |
| Y | 3589.95627300 KM |
| Z | 4747.21404600 KM |
| X DOT | 4.59450900 KM/SEC |
| Y DOT | 2.33546200 KM/SEC |
| Z DOT | -5.45662000 KM/SEC |

## IRV

030006000010GIIRV MANY

1111736801000106000001000037

-000002453063 000000430275 000006620547075

-000005762368 000004298111-000002406705089

00020410015210200 0000000018

ITERM GAQD

## NOR

LandSat 4
1 13367U 82072A 97269.68170567 .00000054 00000-0 21727-4 0 1019
2 13367 98.0144 310.6714 0008013 117.9190 242.2821 14.57211999808476

# *Contact Schedule*

TYPE: SCH
DTG: 1998/072:16:55:05
SCHEDULED EVENT: 7 1998-03-12:**01:12:20** 01:12:26 1998-03-12:01:18:25 **01:18:26** XM 1
SCHEDULED EVENT: 7 1998-03-12:**02:49:38** 02:49:44 1998-03-12:02:59:18 **02:59:19** XM 1
TEXTEND:

# *Calibration Parameter File Report*

FORMATS Product Report

L7CPF19960218_19960517.01xRPT
Date Generated: 1998:076:20:23:08

Product: 301_CALPRM
Incoming File: L7CPF19960218_19960517.01

| Message Type | Message |
|---|---|
| INFO | L7CPF19960218_19960517.01 received by Transform. |
| INFO | L7CPF19960218_19960517.01 sent to Transmit. |

Error count = 0
Warning count = 0
Total Messages = 2

# *Problem Report*

## •Problem Report

### •Used to report potential satellite related problems during downlink rece

TYPE: PRB

DTG: 1990/071:09:45:59

SCHEDULED EVENT: 7 1998-03-11:22:19:18 22:19:24 1998-03-11:22:26:58 22:26:59 XM 1

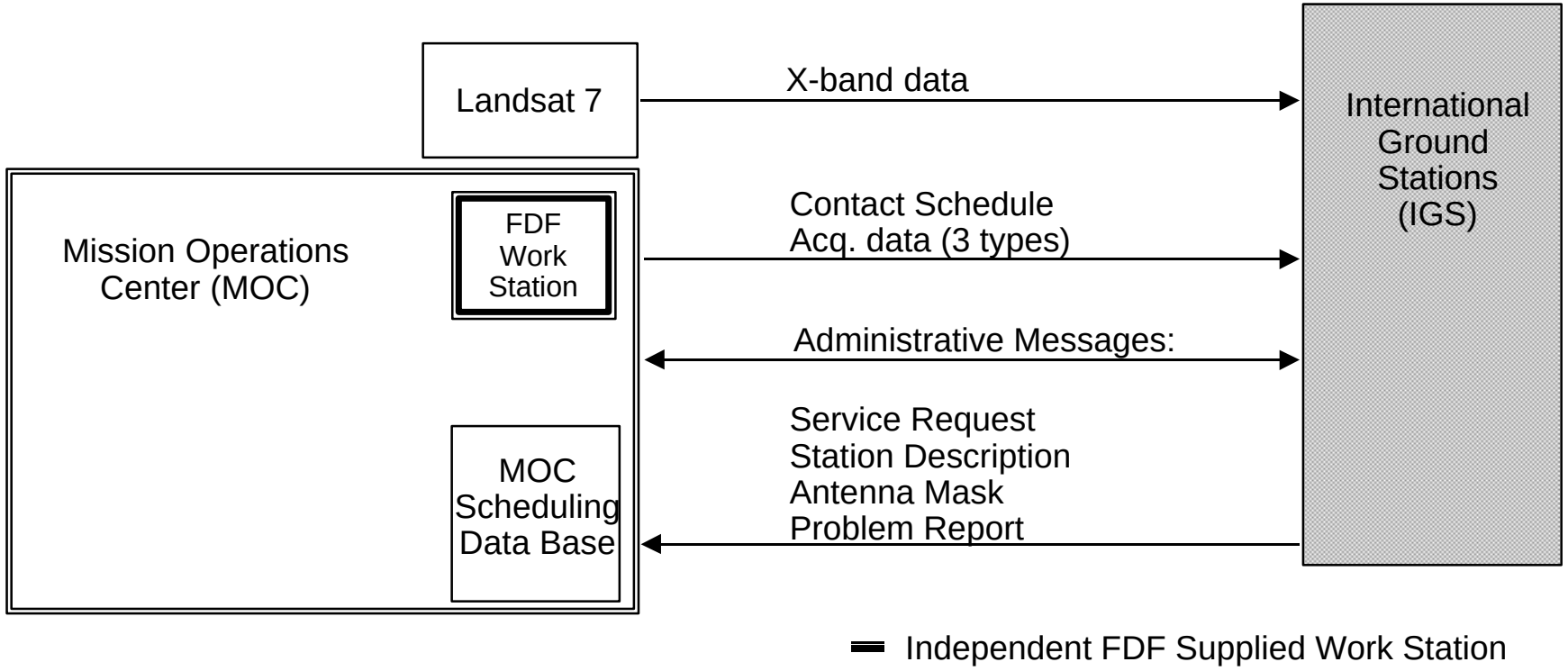
OBSERVATION: "OTHER - SEE COMMENTS"

COMMENTS: THIS PROBLEM REPORT MESSAGE WAS PREPARED FOR THE I&T#6 TESTING

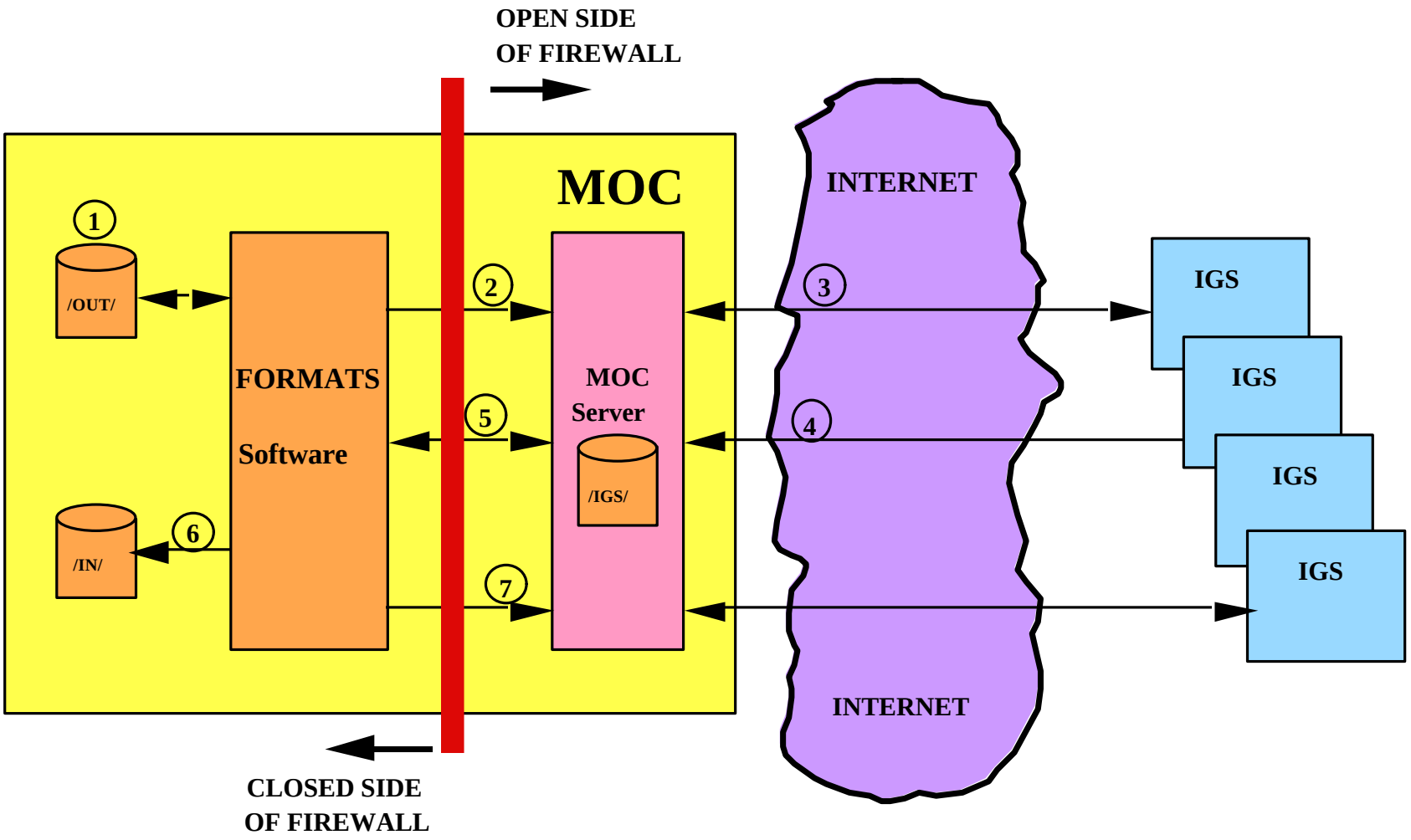
THIS IS NOT A VALID PROBLEM REPORT, TESTING PURPOSE ONLY.

TEXTEND:

# IGS Scheduling Data Flow



# Electronic Transfer - Architecture



# *Non-Imaging Activities*

- **Performed during non-imaging event windows**
  - **IGS Administrative Notification Message sent in advance**

    - **Maneuvers**
      - **All image operations are terminated during maneuver operations.**

    - **General Memory Loads**
      - **All image operations terminated during general memory loads**

# *IGS Image Scheduling*

- **Tools**
- **Resource Constraints**
- **Scheduling Process**
- **Load and Activation**

# *Tools*

- **Scheduler**
  - **The image Scheduler is responsible for producing a conflict free schedule for spacecraft imaging of requested scenes that meets all resource constraints.**

# *Resource Constraints*

- **There are four primary resources defined for satisfying the Landsat imaging scheduling run:**
  - **Enhanced Thematic Mapper Plus (ETM+)**
  - **Solid State Recorder (SSR) storage device**
  - **Spacecraft gimbaled X-band antennas (GXAs)**
  - **Landsat ground stations**

# *ETM+*

- **The Landsat-7 ETM+ is duty cycle limited in the scheduling of spacecraft operations due to:**
  - **Spacecraft not in continuous sunlight (power limitations).**
  - **Thermal limitations do not allow for continuous operations.**

# *Gimbaled X-Band Antennas (GXAs)*

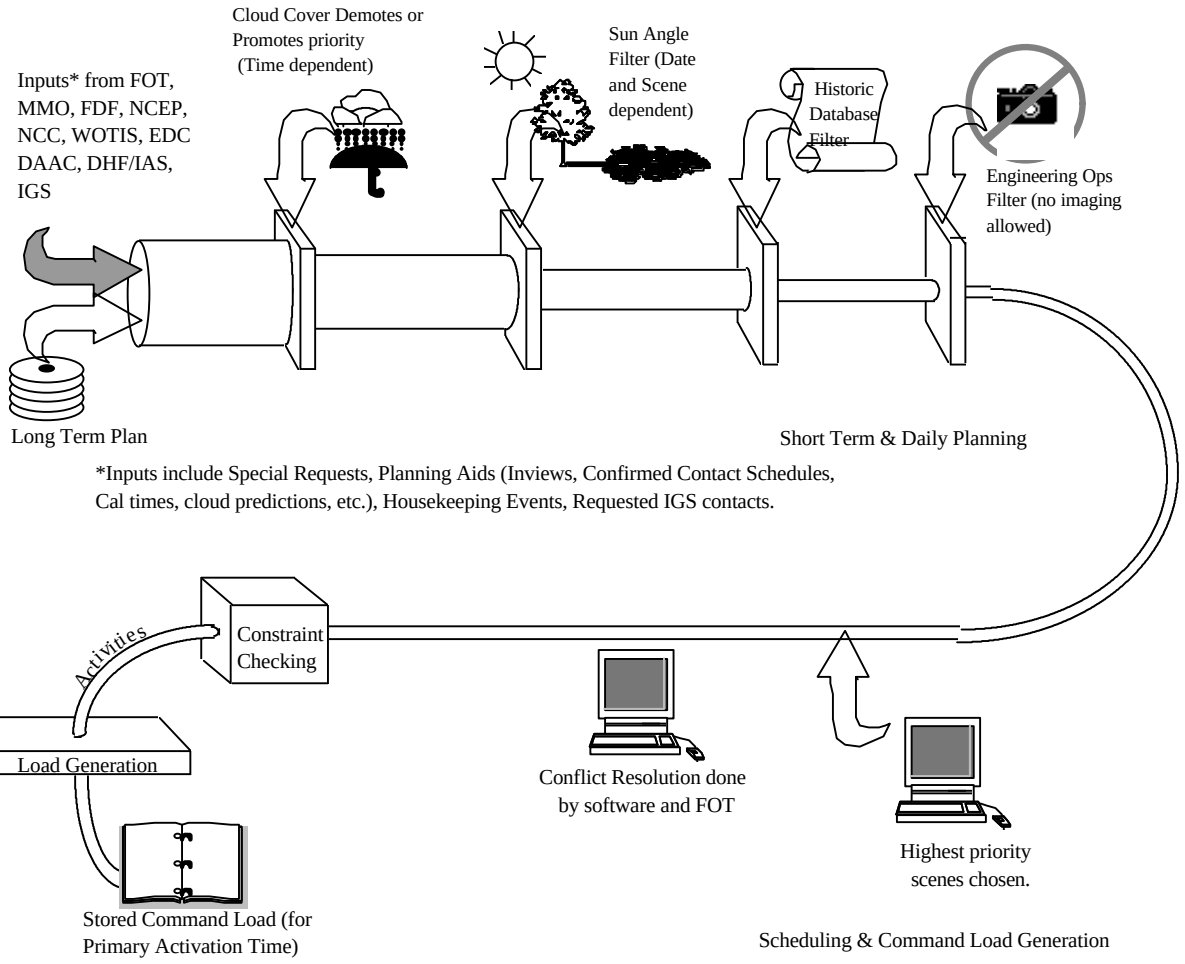
- **Scheduler inserts a GXA slew time**
  - **Each GXA will be allocated a constant slew time of 106 seconds before X-band downlink activation (per On Orbit Handbook)**
  - **Performed autonomously by the MOC scheduler**
- **Each GXA has an associated set of distinct frequencies**
  - **The scheduler matches the correct GXA (with the correct frequency capability (ies)) to the frequency capabilities of the station to which data is to be downlinked.**
  - **GXA1 = M1 or 2**

**GXA2 = H, L**
**GXA3 = H, M1 or 2 , L**

**L = 8082.5 Mhz**
**M = 8212.5 Mhz**
**H = 8342.5 Mhz**

# Scheduling Process

Landsat 7 Planning & Scheduling



# *Dynamic Priority*

- **The Scheduler computes Dynamic Priority from the base priority using the following factors:**
  - **Missed Opportunities - Multiply the Base Priority by the number of missed opportunities since the last successful image acquisition.**
  - **Nearness to End - If no successful image acquisition within the request period, then apply an additional priority boost.**
  - **NTE_Multiplier= (total_opportunities/Remaining_Opportunities)**

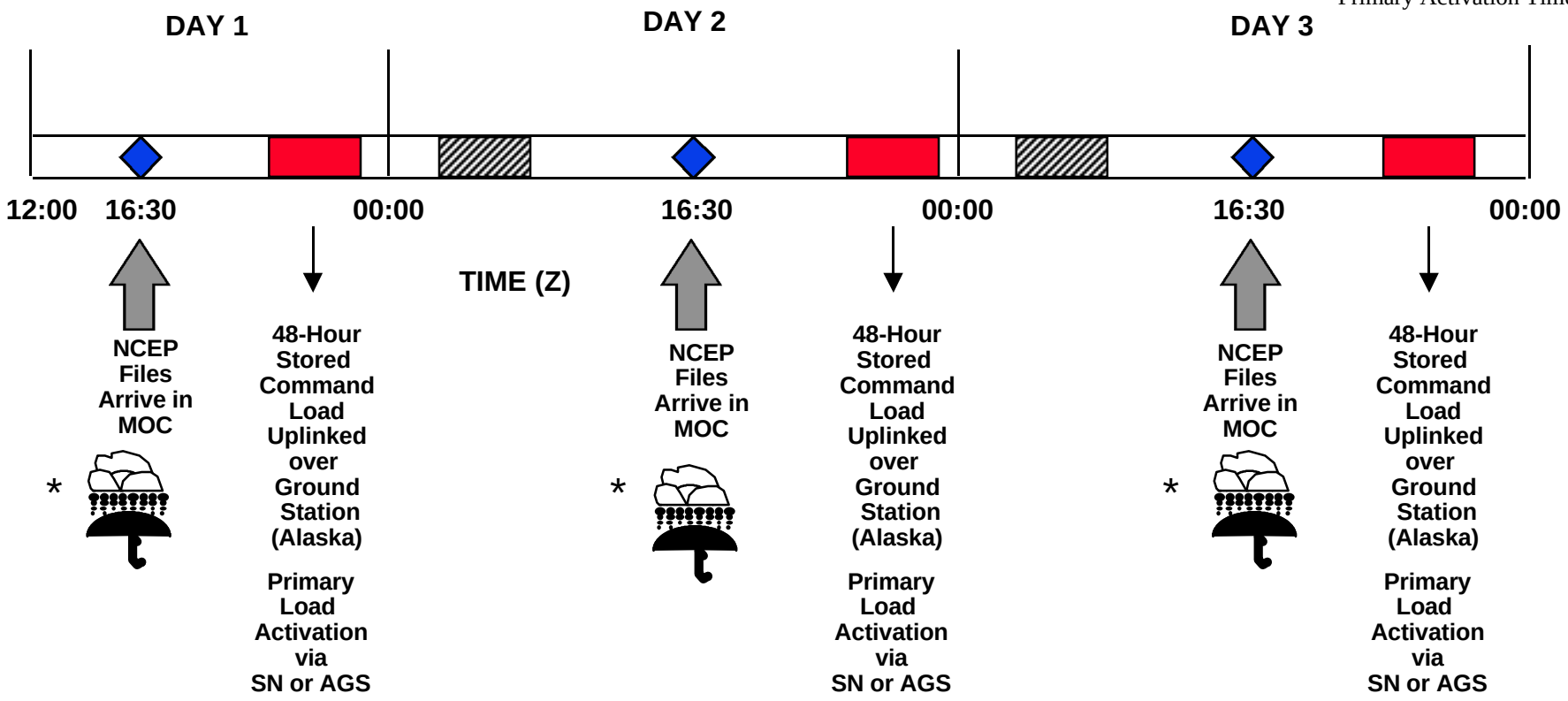
  - **Sensed Nations**
    - **GXA antenna selection criteria will be greater for the IGS station, if acquired is over their territory**
  - **Non-Sensed Nations**
    - **GXA antenna selection criteria will be lower for the IGS station, if not acquired over their territory**

# *Basic Scheduling Algorithm*

- **Scheduler will consider each request one at a time**
- **If resources are available (SSR Capacity, ETM+ has not exceeded Duty cycle constraints, direct downlink available), then the request will be scheduled.**
- **If there are not enough resources available, then the algorithm will search backwards in time to identify enough lower Dynamic Priority, previously scheduled requests to remove in order to accommodate the current request.**
- **If the current request's Dynamic Priority does not rate high enough to replace previously scheduled requests, then it will be rejected.**

# *Load Timeline*

Stored Command Load (for Primary Activation Time)




**Command Load uplink and activation window.**

**Backup Command load uplink and activation window (scheduler run initiated again).**

* All Planning Aids, bus activities files, NCEP, contact schedules (SN, WOTIS), and non-imaging times are needed before the scheduling run is initiated.